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EXPANDED TECHNICAL ASSISTANCE PROGRAM

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Report to the Government

of

IRAN

on

PLANT PROTECTION

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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REPORT

to

THE GOVERNMENT OF IRAN

on

PLANT PROTECTION

by

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FAO/53/9/7202

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INTRODUCTION

In accordance with the provisions of Supplemental Agreement No. 1 signed on 30 April 1951 between FAO and the Government of Iran, the Organization arranged for M. R.L. Steyaert, a Plant Pathologist, to visit Iran for twelve months to advise and assist the Government in improving the plant protection services and to collaborate with a plant breeder in developing disease resistant varieties of cereals and cotton.

The expert arrived in Iran on 17 June 1952 and left on 22 June 1953. He was assigned to the Research Department of the Ministry of Agriculture and worked in the Ministry of Agriculture building. Close collaboration was maintained with Professor Davatchi, Professor of Entomology at Karadj Faculty of Agronomy, and adviser on Plant Protection to the Ministry of Agriculture.

The expert made three surveys: (a) in the Azerbaidjan and Guilan areas, mainly to investigate the Bunt and Smut problems in wheat; (b) in the South-East (Bandar Abbas and Minab - Fars - Esfahan - Kashan) mainly to investigate a lemon tree disease at Minab; (c) in Mazanderan and Gorgan with special emphasis on cereal rusts and fruit and timber tree diseases. Time was not available to visit the important regions of Khorassan, Kermanshah, Hamadan and Khuzistan during the growing season.

During the winter months the expert prepared a post graduate course on forest tree diseases. Owing to the accidental death of the organizer, Mr. Sai, this course was not given, but the material was later incorporated in a handbook in the Persian language.

The FAO expert wishes to record his appreciation of the cooperation of the personnel of the Ministry of Agriculture and of the Seven Year Plan Organization. Especial thanks are due to Professor Davatchi and to Mr. Kaussari, Chief of the Division of Research, Ministry of Agriculture. Their cooperation and helpfulness are deeply appreciated.

IRAN'S PLANT PROTECTION SERVICES

1. Present Status:

The Plant Protection Services now consist of a Research Department under the direction of Mr. Kaussari, a Pest and Plant Disease Control Department under the direction of Mr. Behboudy and a Locust Control Organization. The last, also under Mr. Behboudy, is distinct and operates on a separate budget.

The Research Department comprises an Entomology and a Plant Disease section. The Entomology section is well staffed with eight technicians and an administrative staff, but in Teheran it has only two rooms in the Ministry of Agriculture building. At Esfahan there is a laboratory for the breeding of Telenomus to control the Senn Pest of wheat (Eurygaster integriceps). The Plant Disease section has only two plant pathologists. The equipment and laboratory facilities of the section are very meagre; there are no facilities for carrying out culture work and the library is totally inadequate.

The Plant Pest and Disease and Locust Control Services have a staff in Teheran of ninety-three; the Services also include in addition the agronomists in the Provinces who act as advisers on pest and disease control. This provincial service is mainly concerned in demonstrating pest control techniques, such as control of coccids on orange trees in the Caspian area, control of Idiocerus estali on pistachio, control of Eurygaster integriceps on wheat, and of Heliothis obsoleta on cotton.

The Research Department publishes a review, "Nashril Afât va Bimarihaye Nabâti", with French summaries under the title of "Entomologie et Phytopathologie Appliquées." Publication is at present interrupted though in the past this Review has published valuable information on the pests and diseases of Iranian crops. A number of papers on Iranian fungus flora have been published in "Sydowia". The records of the distribution and nature of plant diseases in Iran are however very incomplete and the facilities for obtaining and recording this information are inadequate.

2. Suggested improvements:

A. Organization:

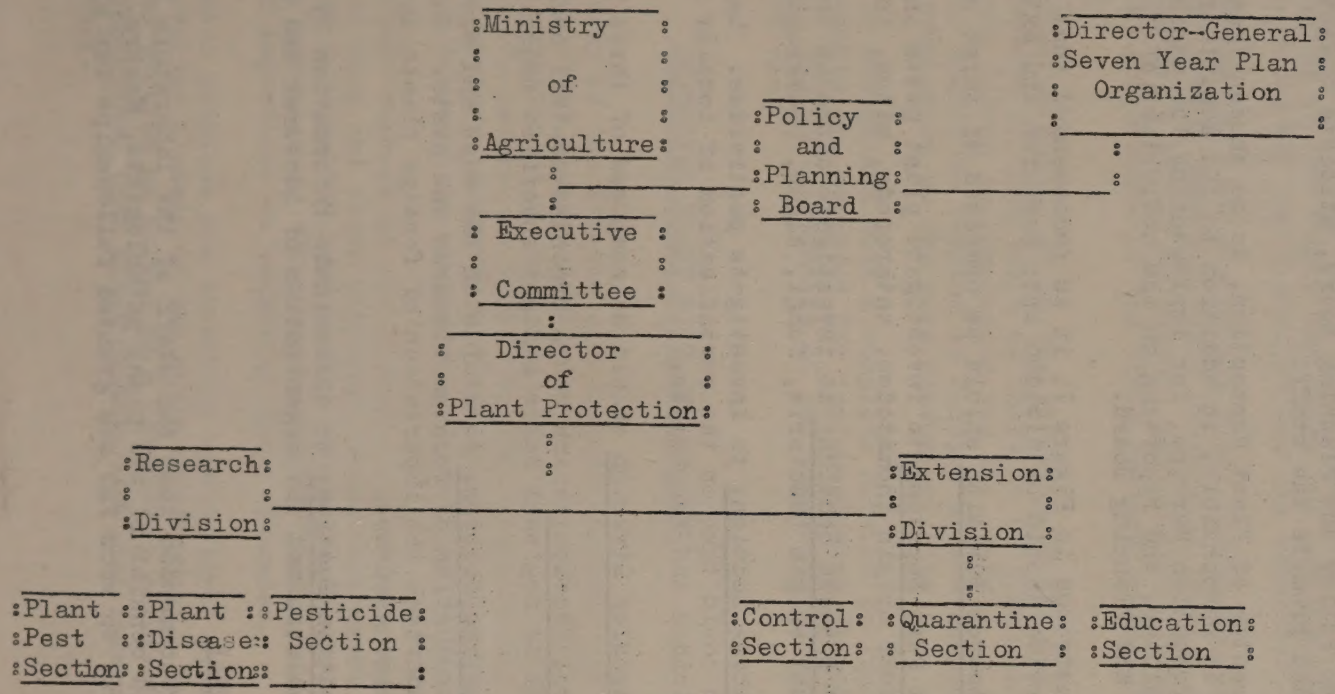
In many countries it has been found that there is some incompatibility between purely administrative services and technical services. The FAO expert believes that the technical services in Iran could be materially improved by the establishment of a separate organization similar to the specialized "bongahs" now operating in the country, that is, by a semi-autonomous government-sponsored agency. He suggests the re-organization of the Plant Protection Service on the lines shown in Figure 1 which indicates the relationships of the bodies which would be responsible for the administration, guidance, supervision and conduct of pest control work.

It is suggested that the Minister of Agriculture, advised by a Policy and Planning Board, should direct the Plant Protection Service through an Executive Committee.

The Policy and Planning Board, composed of members chosen by the Prime Minister from candidates submitted by the Ministry of Agriculture, the Plan Organization, the Faculty of Agriculture of Karadj, the Faculty of Natural Sciences of Teheran and the specialized Bongahs, would meet once or twice a year for the purpose of reviewing the Executive Committee's report and directing and co-ordinating future programs and other policy matters. The Board would report to the Minister of Agriculture.

PROPOSED ORGANIZATION OF THE PLANT PROTECTION SERVICE

FIGURE I



The Executive Committee, with the Director of Plant Protection as Chairman, should be composed of the Division and Section Chiefs of the Plant Protection Service. The Committee would implement the plans and policies of the Policy and Planning Board, allocate budgetary funds, and nominate and promote the staff.

The Director of Plant Protection, to be chosen from the Division Chiefs, would be responsible, in addition to the administration of the whole Plant Protection Service, for implementing the decisions of the Executive Committee, and reporting on the activities of the organization to the Policy and Planning Board.

As illustrated in Figure I, it is recommended that the Plant Protection Service should be divided into Research and Extension Divisions.

The Research Division should be composed of three sections:

a) A Plant Pest Section: to investigate plant pests and parasites of zoological origin (nematodes, anthropods, mites, insects, mammifers);

b) A Plant Disease Section: to investigate diseases and parasites of botanical origin (bacteria, fungi, algae, phamerogams, viruses);

c) A Pesticide Section: to investigate pesticides. Later on this section could take on the certification of locally produced insecticides and fungicides.

The Extension Division should be composed of three sections:

a) A Control Section: which would organize control campaigns on a national or regional basis against specified major diseases or pests.

b) A Quarantine Section: to deal with the ways and means of preventing the introduction of foreign diseases and pests. This section could also undertake the importation of foreign plants and establish quarantine gardens.

c) An Education Section: to disseminate information by the publication of pamphlets, and the organization of lectures and demonstrations.

B. Personnel:

It is recommended that the staff of the laboratory for plant disease research should consist of two plant pathologists, Messrs. G.E. Sharif and A. Manoutchehri, to whom FAO has granted fellowships for study abroad.

It is suggested that the services of a foreign expert in plant pathology might also be obtained to advise and assist the two fellows upon their return in setting up the laboratory, in completing the surveys and in initiating studies of diseases not yet well defined.

C. Laboratory Facilities, Equipment and Location:

Before any practical control work can be undertaken it is essential that the plant disease be diagnosed. After diagnosis it may be necessary to study the etiology of the fungus and carry out experimental inoculations. For this adequate equipment and installations are essential.

In considering the location of the Plant Protection laboratories it should be kept in mind that the Plant Protection Service should become ultimately an integral part of the overall agricultural research organization. At least, all the laboratories of the Plant Protection Service should be grouped together.

Sites, either in Karadj or in the vicinity of Teheran may be considered. Karadj for the present is unsuitable as there is no permanent electricity supply nor adequate living accommodation for the staff. As the Plant Protection Service should be located to receive many visitors requiring information, Teheran would be the more convenient site.

While it is recognized that a complete service is somewhat costly, suggested improvements are proposed for implementation as and when funds become available. The cost estimates of the suggested improvements are listed in Appendix III.

PRINCIPAL PLANT DISEASES OF IRAN

The diversity of the Iranian agricultural regions and crop distribution has a bearing upon plant disease distribution. As an example, in the wheat rain-fed regions, wheat bunt is more prevalent than loose smut. In the irrigated regions the reverse is true. In the comparatively high rainfall regions with mild winters along the Caspian littoral, the variety and destructiveness of diseases is very much greater than on the plateau.

During disease surveys it was observed that faulty agricultural practices, such as deep and close planting, unsuitable graft stocks, primitive means of cultivation, and faulty irrigation methods greatly influence disease prevalence. The improvement of farming operations, therefore, is of major importance in combating plant diseases.

Plant disease problems are basically agricultural problems and their solution involves a study of the whole environment. Very rarely will a specific disease problem be solved by a laboratory examination and it is of the greatest importance that plant disease and pest research workers should travel freely.

I. DISEASES OF ANNUALS

a) Wheat:

(i) Bunt: Tilletia tritici and T. foetens are reported from Iran but specimens collected were only of the latter species. As the different wheat regions were not visited at the same periods of growth no definite statement can be given. However, high bunt infestations were noticed only in the rain-fed regions and especially in Meshgin Shahr and Asgar Abad in northern Azerbaidjan where infestations ran as high as 30%. Meshgin Shahr, because it is situated in an important wheat producing region, should be selected for the organization of a pilot scheme for the improvement of agricultural practices in conjunction with seed treatment.

This pilot scheme should include:

1) a one variety community after proper selection of the best adapted to the region;

2) a cooperative seed cleaning plant;

3) a cooperative seed disinfection plant.

At present the farmer sows the harvested seed which contains many weed seeds and bunted kernels. These bunted kernels, which seed cleaning and seed disinfection could practically eliminate, maintain a high soil infestation. Reduction of the soil infestation, however, will be obtained only after several years of using clean seed. Opportunity should be taken to introduce further improvements when the pilot schemes are set up. Local conditions should be studied by an agronomist whose investigations would suggest improvements in agricultural practices to be progressively introduced.

(ii) Loose Smut: Ustilago tritici. Although some infestations are reported, none higher than about 5% was observed. However, too few fields were visited at the right time to obtain a clear idea of the importance of smuts. Reduction of loose smut infestation can be obtained practically only by selection of resistant strains. In carrying out normal selection care should be taken to subject the strains under study to artificial infections to the utmost extent possible. Enough inoculum can be gathered in the fields and stored for the next season.

b) Barley:

(i) Covered Smut: Except in the hotter southern regions of Iran, barley is not a staple food and is largely used as animal feed. It is therefore of secondary importance to wheat and though covered smut infestation (Ustilago hordei) would yield to seed treatment, infestations are not high enough to necessitate action being taken at present.

(ii) Alternaria Disease: In the experimental plots in Gorgan (FAO barley rust nursery and Arâghe Mahalle) a spotting of the leaves was noticed and an Alternaria detected on the lower leaves. In the experimental plots clear indications were seen that a strain susceptibility existed, sometimes to such an extent as to do considerable damage. This disease may therefore be dangerous under favourable conditions.

c) Cereals:

Rusts: Only Puccinia glumarum and P. hordei have been observed as important rusts. P. triticina is less active and P. graminis has not been observed. According to reports rusts are not important on the Iranian plateau. The only critical regions are in Gorgan and some mountain valleys in the Elborz. The FAO expert saw no signs of rusts in Fars in April. In Azerbaidjan some sori were observed on straws, but this does not permit a determination of the importance of rusts in that region. Rezayeh with its more humid environment might be another critical region.

In Gorgan the local varieties appear to be sufficiently resistant to rusts, but rusts in that region and in Mazanderan are potentially important. In the Arâghe Mahalle experiment fields some varieties, notably the Karadj variety 9666, were attacked 100%. The seeds of these varieties should not be destroyed as they are useful for experimental purposes. They should be included in all tests to keep the highest possible infestation of rusts in the trials.

d) Rice:

Little evidence of any identifiable disease was observed, but rice at the proper stage was only seen in Northern Azerbaidjan.

e) Tobacco:

Few tobacco diseases were seen but travels were performed out of season. Fusarium oxysporum var. nicotianeae was observed in Minab. Because this disease is seed borne and thus it results in a permanent soil infestation, care should be exercised that no seeds are exported from that district.

Pythium de baryanum and Thielavia basicola are known seed-bed diseases and are kept under control. Erysiphe cichoracearum is prevalent and cannot be controlled as sulfur would leave an objectionable taste, and potassium permanganate is harmful to the foliage. Bacterium angulatus is a known disease but does not appear to be troublesome at present.

f) Horse bean:

The disease Uromyces fabae is very important in the Caspian area. Selection or introduction of resistant varieties should be investigated. A "yellow" disease, possibly caused by a virus, was observed in Fars. This disease should be investigated further.

g) Broom rapes:

Orobanche spp. are prevalent over the whole of Iran especially on cucurbits and tobacco. The control of these parasitic plants has not received much attention in Iran; picking the plant before it seeds is the present means of control and should be adopted more widely. Deep ploughing with a mould board plough should bury the seed effectively; this may prevent the germination of a considerable number of seeds, and thus reduce the infestation. Other measures of control should be studied.

h) Cotton:

Cotton in Iran appears to be remarkably free from disease. Important insect pests such as Heliothis obsoleta and Earias insulana can be very troublesome. A wilt, either Fusarium or Verticillium, observed on isolated plants in Northern Azerbaidjan, is not yet economically important, but its progress should be watched carefully. Iran could be one of the countries with the highest yield of cotton per surface unit if proper care and cultivation methods were practised. Broadcast sowing, lack of fertilizers, unsuitable irrigation methods, are all practices which need improvement.

In the expert's opinion, the Iranian government should give particular attention to cotton production, as it is one of the principal cash crops of the Iranian farmer and one of the few exportable agricultural products.

i) Opium poppy:

A disease involving the stunting of the plant has been observed. The cause of the disease should be investigated. An Alternaria has been observed but it may be a contaminant.

j) Cucurbits:

Several diseases have been reported but none has been investigated. From reports and the description of the symptoms, a "Wilt" is probably causing considerable damage in the Esfahan region. This disease should be investigated carefully.

k) Carnation (Dianthus):

Fusarium dianthi and Uromyces caryophyllinus have been observed near Teheran. The latter specially is widespread and causing

considerable damage. Sulphadiazine, as 0.1% of sodium salt, sprayed on the plant might be tested as a fungicide. This has been reported as preventing the appearance of rust pustules on wheat.

Fusarium dianthi being a soil contaminant, the soil should be sterilized in the event of the disease appearing.

Both diseases have apparently been introduced recently.

II. DISEASES OF PERENNIALS

Fruit Trees:

a) Pome and Stone fruits: Rosellinia necatrix is a widely distributed root disease. Its high rate of prevalence is, however, the result of agricultural malpractices, details of which will be found in Appendix I.

Details of other fruit tree diseases will not be given as they are too numerous. Attention, however, must be called to the gumming disease of the cherry, prevalent around Teheran, and the gumming disease of the apricot tree discovered in Mazanderan. Lack of laboratory facilities has prevented a close study of these diseases. The bark disease of the quince, discovered in Kalardasht, is also very harmful.

b) Vines are commonly attacked by Uncinula necator. The methods of control are known and applied by the more progressive planters.

c) Citrus: Much should be done to put the citrus industry on a secure footing. In the first instance, there is a need for a citrus specialist to determine more suitable areas and to set up experiment stations and experiment fields in Minab and other suitable places in southern Iran.

The northern citrus areas should be studied. It appears that severe frosts occurring periodically every ten or eleven years render orange growing in these areas very hazardous. The reorganization of the Ramsar Citrus Station should be undertaken as its work does not appear to be consistent. Perhaps a better site could be found.

The orange trees in this region suffer considerably from foot rot gummosis. The best remedy is to graft on resistant sour orange stock (Narendj). Details of the inarching method (to save the trees actually attacked by the disease) have been provided.

The problem of the citrus plantations in Minab and other agricultural problems of that region are discussed in Appendix II.

d) Almonds:

The almond plantations in Nadjefabad, near Esfahan, are typical of the detrimental effects of deep planting. The trees are attacked on the buried part of the trunk by Rosellinia necatrix. Previously apricot cultivation had been favored in this area, but when all the apricot trees had died almond cultivation was started. The fungus was probably responsible for the disappearance of the apricot trees.

III. DISEASES OF TIMBER TREES

Considering the importance of lumber to Iran, most careful attention should be given to diseases of timber trees.

a) Poplars:

Poplars are planted extensively in many districts and especially in Azerbaidjan. Cytospora chrysosperma is doing a considerable amount of damage. This disease, though well known abroad, has received very little study. The etiology of the disease should be studied as a prerequisite to devising control methods.

b) Nut Tree: (Juglans regia)

The nut tree primarily cultivated for its fruit is included in this section as it also grows wild in extensive forest on the Alborz Mountains.

In Kalardasht most of the trees are severely attacked by one or several diseases. At least three fungi were identified on dying branches. A detailed study of these diseases should be carried out to determine whether all are primary pathogens.

c) Zelkova crenata:

The nature of the disease producing a die-back of the branches of this tree has not been determined.

RECOMMENDATIONS:

I. Organization of the Plant Protection Services:

It is recommended that:

a. The Plant Protection Services should be separated from the purely administrative services of the Ministry of Agriculture and organized on a plan similar to the existing "Bongahs" but with some administrative changes.

b. The Plant Protection Bongah should be directed by a Director, with the assistance of an Executive Committee and the guidance of a Policy and Planning Board.

c. The Bongah should be divided into (a) a Research Division comprising a Plant Pest Section, a Plant Disease Section and a Pesticide Section, and (b) an Extension Division comprising a Plant Pest and Disease control Section, a Quarantine Section and an Education Section.

d. Laboratory facilities should be provided in the very near future for the Plant Disease and Plant Pest Sections.

II. Improvement in Cultivation Practices:

As cultivation malpractices have an important bearing on disease prevalence, it is recommended that the following steps should be taken:

a. Broom Rapes (Orobanche spp.):

Wherever broom rapes cause considerable damage to cucurbits or tobacco, a mold board plough should be used to bury deeply the seed of this parasitic plant. Destruction of all seed-bearing stems should be applied generally.

b. Fruit and Ornamental Tree Root Diseases (See Appendix I)

As deep planting leads to a high incidence of root diseases, it is highly recommended that trees be planted with the collar at soil level.

The "Albalou" cherry is an unsuitable stock for the "Gilass" cherry. "Gilass" should be grafted on to "Gilass" until a better stock can be found.

III. Control of Specific Diseases:

a. Wheat Bunt and Cereal Smuts:

A pilot scheme for the control of wheat bunt should be set up in Meshin Shahr in Northern Azerbaidjan.

All cereal breeding programs should include as a normal procedure the artificial inoculations of seeds or flowers with Bunt or Smuts.

b. Cereal Rusts:

The 9666 strain of wheat produced at Karadj, which is very susceptible to Puccinia glumarum, should be kept as a source of inoculum in the breeding programs of the various breeding stations. This strain should enclose all breeding plots.

c. Citrus:

1. The services of a Citrus expert should be obtained to reorganize the Ramsar station and establish a station in Minab.

2. In the Caspian area the orange trees should be grafted on to sour orange stock (Nârandj) to control foot rot gummosis (Phytophthora citrophtora). Badly affected trees should be grafted with the sour orange by "inarching".

3. A full program of investigations on citrus, dates and other fruit should be undertaken at Minab (for detailed recommendations see Appendix II).

d. Diseases Needing Investigation:

Work should be started on a number of diseases as soon as the laboratory is completed; among those needing study may be mentioned:

Poplars: Cystospora chryosperma
Cherry and Apricot Trees: Stem and branches gummosis
Nut Tree (Juglans regia): Branchlets die-back
Zelkova crenata: Branchlets die-back
Opium poppy: Stunting disease discovered in Fars
Horse bean (Faba vulgaris): "Yellows" disease discovered in Fars
Melons: The reported "wilt" around Esfahan
Plane tree (Platanus orientalis): The die-back observed in Sultanabad
Cotton: The "wilt" observed in Northern Azerbaidjan.

APPENDIX I

OBSERVATIONS ON ORCHARD PRACTICES

Orchard growing in Iran can be greatly improved by adopting improved cultural methods. It has been repeatedly observed that too deep and too close planting, unsuitable graft stocks, and lack of pruning not only reduce the yield of fruit but favor the advent of disease and ultimate death of the trees.

Deep planting, the most common malpractice, seems to spring from the idea that trees planted in that manner will be favored with respect to soil water. This is fallacious for it has been observed repeatedly that roots of deep planted trees have a tendency to grow upward. The photograph, Fig. 2, illustrates this fact and is typical of the root systems of fruit trees in Iran.

The upward growth is a natural response of the roots to seek aerated soil. The roots not only need to absorb water and dissolved nutrients but they must also find air and oxygen which occur only in the upper layers of the soil. Furthermore, the buried part of the stem of trees planted with the collar very much below ground level is easily attacked by fungi. The main damage in Iran is due to the fungus Rosellinia necatrix, illustrated in photograph, Fig. 2. Trees should be planted level with the soil surface in order to avoid this disease.

The photograph also shows the damage caused by unsuitable root stock. The "Albalou" cherry has a stem much smaller in diameter than that of the "Gilass" cherry. There results an unsuitable graft combination and a weak rooting system. The "Gilass" cherry should preferably be grafted on to itself.

APPENDIX II

SPECIAL PROBLEMS IN THE REGION OF MINAB

The disease "wither tip" has become prevalent on lemon trees in the Minab district. "Wither tip", and the fungus disease associated with it - Colletetrichum gloeosperioides, are known as diseases brought about by unsuitable environmental conditions, unfavorable soil conditions and cultivation practices. It has been observed in this region that the trees are deep planted and over-irrigated. Basin irrigation is practised with 50 cm of water applied every fortnight. No pruning is undertaken, thereby giving the tree an inextricable mass of vegetation. The solution of the problem, therefore, involves more than the simple control of a pathogenic fungus and will require careful experimentation in soil improvement and cultivation practices.

Citrus culture is not the only problem needing solution. A date palm grove, about 30-40 km long by a few km wide, containing about 3,000,000 trees needs study. An uneven distribution of irrigation causes the outlying parts of the grove to dry out for lack of water, whereas the central portion receives an excess of water. A more rational distribution of water can certainly be obtained. This problem should be investigated by the Bongah Abiari.

Besides the date palm, mangoes, guavas, and Terminalia catappa grow well. No doubt other tropical fruits also could be grown. Possibly the banana, such as the Canaries variety which might constitute a profitable export trade.

The importance of fruit pproduction in the region of Minab and the variety of problems warrant the establishment of an Agricultural Experiment Station in that region. The FAO expert, in conference with planters, has suggested the formation of a syndicate to assume a financial interest in the Agricultural Experiment Station, in cooperation with the Government. The possible returns from an increase in the export of lemons should encourage growers to support this proposal.

Furthermore, as the syndicate gained experience in management and in cooperation, it could start a small lemon juice factory, and thereby increase the grower's profits and lower the export costs.

Considering the grave situation existing in Minab, the FAO Expert recommends that an Experiment Station should be established and a full program of investigations initiated.

Indications of some of the investigations which should be conducted in the field and on the Experiment Station are given below.

1. Field Experiments:

A. Cultivation Practices:

An experimental program should be undertaken immediately in orchards suffering from "wither tip" in an attempt to control the disease by soil improvement and cultivation practices.

B. Spraying Experiments:

Two formulae of Burgundy mixture are recommended. The Burgundy mixture is suggested because it is doubtful if a good grade of lime is obtainable for a Bordeaux mixture.

(i) Formula I:

Water	100 liters
Copper sulfate	1 kg.
Zinc sulfate	1 kg.
Sodium carbonate	2 kg.

(ii) Formula II:

Water	100 liters
Copper sulfate	2 kg.
Sodium carbonate	2 kg
Potassium permangan.	100 gr.

The two formulae besides their fungicide value may correct the most common deficiency disease in citrus: namely zinc and manganese.

C. Soil-Fertilizing Experiments:

Discussion of the soil problem with the FAO soils expert, Mr. Dewan, has suggested that incorporation of sulphur in the soil, as such, or in combination in the form of gypsum, should be tested. Considering local conditions, it is believed better for the time being to apply for sulphur alone. Quantities of 150 kg., 300 kg., and 600 kg. per hectare should be tested. Details of plot layouts have already been provided.

II. Experiment Station Program:

A. Citrus:

(1) Irrigation:

There is evidence that the fields in Minab are "over-irrigated". Channel irrigation or sub soil irrigation methods might be tested. The irrigation problem should be examined by the Irrigation Bongah and the FAO irrigation team.

(2) Soil Treatments:

a. Fertilizers and Other Materials:

Nitrogenous and phosphatic fertilizers, and sulphur and gypsum, should be tested.

b. Cover Plants:

Deep rooting plants should be tested to determine their adaptability to conditions in Minab and their value in opening up the soil and in providing large amounts of green manure to be dug in.

(3) Cultivation Experiments:

a. Introduction of Improved Citrus Stocks:

Lemon "wither tip" can be partially controlled by grafting on to sour orange stock. This operation can be carried out by the planters as they have enough sour orange trees to provide the stocks. However, the introduction and testing of citrus species and varieties in Minab should be undertaken with a view to developing new and improved varieties of citrus. The variety of lemon now cultivated in Minab could be improved in flavor.

b. Planting Methods:

Deep-planting should be discontinued. Better seed beds and nurseries should be demonstrated. Spacing experiments should be undertaken and the benefits of proper pruning and grafting demonstrated.

B. Date Palms:

The dates produced in Minab are of an inferior quality. The introduction of a better quality date and improvement of cultivation methods, with proper irrigation and uniform age of planting, would surely increase production.

C. Other Fruits:

The introduction of the banana should be tested and possibly the passion fruit for the manufacture of fruit drinks.

APPENDIX III

COST ESTIMATES OF RECOMMENDED IMPROVEMENTS IN PLANT PROTECTION

The following itemized cost estimates for the construction, equipment, and maintenance of a phytopathology laboratory, have been prepared by the FAO expert. They cover the items believed to be essential for a well-equipped laboratory for plant disease research.

The improvements that are suggested for the Plant Disease Research Section should be duplicated for the Plant Pest Research Section. Neither are properly housed or equipped. The provision of well-equipped laboratories for the one and not for the other would only lead to chaos in later years as these two sections must work together in harmony. The Plant Protection Service should be considered as one inseparable unit. It is advisable, therefore, to provide funds also for the Plant Pest Section. Construction of buildings for both sections should be undertaken at the same time.

A. Investments:

(i) Building: The phytopathological laboratory building should comprise:

One general purpose laboratory room approximately	6 x 7 m	42 m2
Microscope and balance room	5 x 5 m	25 m2
Two offices	5 x 5 m	50 m2
Herbarium room	5 x 5 m	50 m2
Culture room	3 x 3 m	9 m2
Kitchen and autoclave room	4 x 4 m	16 m2
Store room	4 x 4 m	16 m2
Toilet room	4 x 4 m	16 m2

It should be equipped with cellars, cistern, water distribution and electricity. The estimated outlay is approximately 1,000,000 rials.

(ii) Site: As the area must be large enough for the building of Entomology sections and eventually for a Pesticide and Chemical Section, a ground surface of about one hectare will be required. If Government land is unavailable for the site, then a suitable location should be purchased. The estimated price is approximately 1,000,000 rials.

(iii) Equipment:

Microscopes and optics	300,000 rials
General laboratory equipment	500,000 "
Books and reviews	400,000 "
Laboratory furniture and office equipment	500,000 "

(iv) Vehicles:

It is of the greatest importance that the laboratory should be assured the permanent use of a Jeep Station Wagon 4 wheel drive 300,000 rials

B. Maintenance (Annual)

(i) Staff:

Two Plant Pathologists	192,000 rials
One laboratory attendant	60,000 "
Two janitors and gardeners	72,000 "
One typist	60,000 "
One chauffeur	60,000 "
(ii) Travel expenses and upkeep of car	40,000 "
(iii) Supplies	60,000 "
(iv) Books and Periodicals	30,000 "
(v) Publication of pamphlets	30,000 "

C. Recapitalution - Cost Estimate:

Investments:

Ground and building	2,000,000 "	
Equipment - Microscopes and optics	300,000 "	
General laboratory equipment	500,000 "	
Books and reviews	400,000 "	
Lab. Furniture-office equipment	500,000 "	
Jeep Station Wagon	300,000 "	4,000,000 rials

Maintenance:

Staff and travel expenses	484,000 "	
Supplies	60,000 "	
Books and periodicals	30,000 "	
Publication of pamphlets	30,000 "	604,000 rials

FIGURE 2. - Illustration of unnatural root growth and fungus disease due to planting collar below soil level. Also damage caused by unsuitable root stock.